FIROUZI CONSULTING ENGINEER, INC.

| SKYTRON SURGICAL PRODUCTS	DES.	SHEET
LFSLFSst2323 FOR SEISMIC ZONE (4), SOIL PROFILE (Sd) NEAR SOURCE FACTOR = 1.5	FCE JOB No. DATE: 4–6–04	**1** OF 4 SHEETS

SEISMIC ANCHORING BOLT DESIGN
LFSLFSst2323

*BY OTHERS:
EQUIPMENT STRUCTURE SUPPORT AND
BRACING IS OUTSIDE SCOPE OF THIS
WORK, AND MUST BE DESIGNED AND
DETAILED BY ENGINEER OF RECORD

2.5" MAX

FINISH CEILING

MOUNTING PLATE

D

V

Y

60°

REGISTERED PROFESSIONAL ENGINEER
HOMAYOUN J. KHADVI
No. 2798
STRUCTURAL
STATE OF CALIFORNIA

RENEWAL FEE DUE DATE: 06–30–06
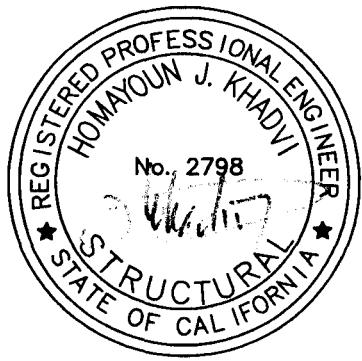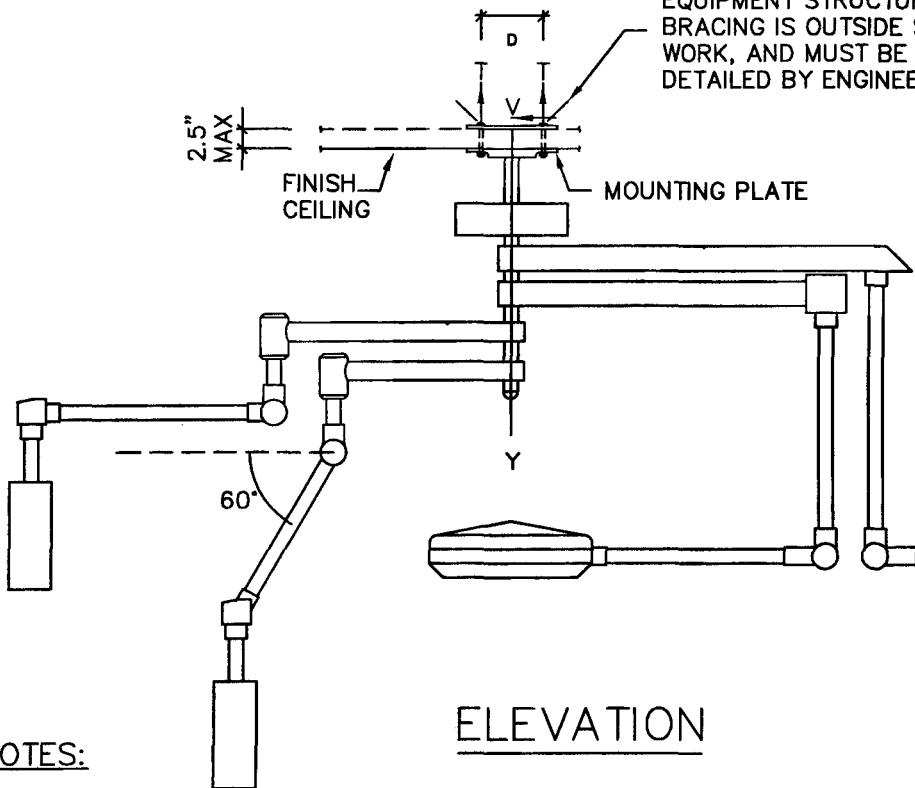
ELEVATION

NOTES:

1. SCOPE OF WORK: DESIGN OF BOLTS CONNECTING MOUNTING PLATE
   TO STRUCTURE ONLY.

2. FORCES ARE DETERMINED PER 2001 CALIFORNIA BUILDING CODE –
   SECTION 1632A, (INCLUDING UP TO DATE REVISIONS) AND HAVE BEEN
   FACTORED TO REPRESENT WORKING DESIGN LOADS, NOT ULTIMATE

3. FORCES ARE MAXIMUMS AND OCCUR WHEN EQUIPMENT IS MOVED TO
   ITS MOST ECCENTRIC POSITION.

4. PROVIDE CEILING STRUCTURE DESIGNED AND DETAILS TO SUPPORT
   WEIGHTS AND FORCES SHOWN (BY ENGINEER OF RECORD FOR THE BUILDING)

5. ENGIINEER OF RECORD TO DESIGN, DETAIL AND VERIFY STRUCTURE AND/
   OR EXISTING LIGHT SUPPORT TRACTS TO SUPPORT INDICATED LOADS

6. HORIZONTAL FORCES AND MOMENT MAY OCCUR IN ANY DIRECTION,
   ACTING AT THE TOP OF MOUNTING PLATE.

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DESIGN CRITERIA:

FORMULA 32A-1: $F_P = 4.0\ Ca*Ip*Wp$

TABLE 16A-Q   : $Ca = 0.44*Na = 0.44*1.5 = 0.66$ (For zone 4 & S_D)

TABLE 16A-K   : $Ia = 1.5$ (For essential facility)
  $\therefore\ F_P = (4.0)(0.66)(1.5)Wp = 3.96\ Wp$ (For LRFD)
  $F_P = 3.96Wp/1.4 = 2.83Wp$ (For ASD)

FORMULA 30A-1: $E = p*Eh + Ev$
  $Eh = F_P$
  $p = 1.0$ (FOR COMPONENT)

  $Ev = (0.5)Ca*Ip*Wp$
    $= (0.5)(0.66)(1.5)Wp = 0.5Wp$ (For LRFD)
                $= 0$ (For ASD)

SECTION 1630A.11: $Ev = (0.7)Ca*I*Wp$
    $= (0.7)(0.66)(1.5)/1.4 = 0.5Wp$ (For ASD) [NET UPLIFT FORCE]

LOAD COMBINATION CASE A

$$Eh = Fp$$

$$DL + Ev$$
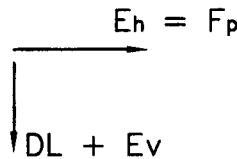
LOAD COMBINATION CASE B

$$Ev = 0.5DL$$

$$Eh = Fp$$
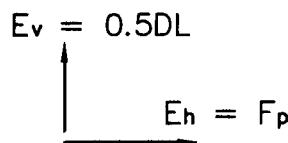
BY COMPARISION LOAD, COMBINATION A GOVERNS

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CASES I & III

S : Shear/bolt
Momment/bolt: m
t: Direct tension/bolt
t': Flexual tension/bolt
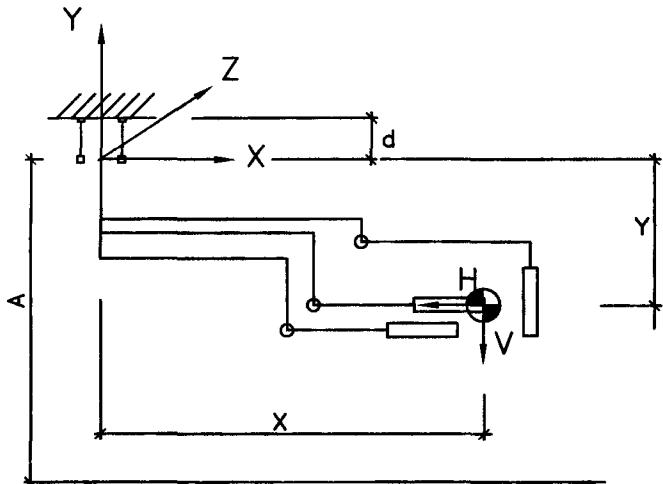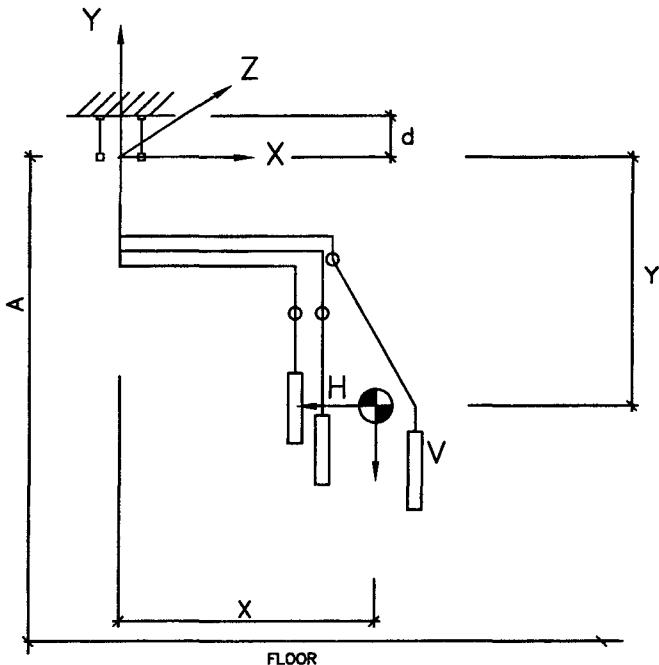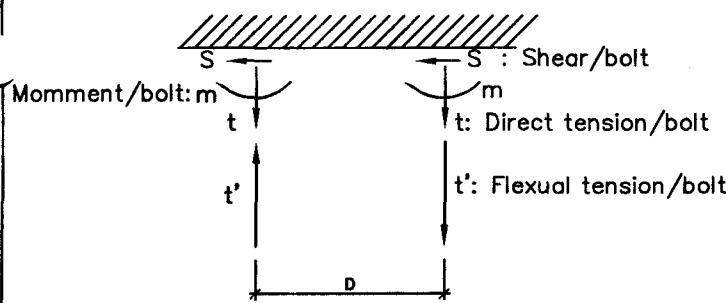
CASES II & IV

A: MAX FLOOR TO MOUNTING PLATE DISTANCE
$A = 10'\text{-}0'' = 120''$
V_d : Dead Load (= DL)
V_e : Vertical Seismic Load (= Ev)
H_e : Horizontal Seismic Load (= Eh)

CASE I (FIXTURE AT HIGH POSITION)

$d = 2.5\ ''$
$D = 9.5\ ''$
$V_d = 135.0 + 135.0 + 100.0 + 100.0 = 470.0\ \#$
$Y = 120.0 - 80.0 = 40.0\ ''$
$X = (135.0 \times 90.1 + 135.0 \times 82.5 + 100.0 \times 70.5 + 100.0 \times 62.8)/ 470 = 77.9\ ''$
$V_e = 0.50 \times 470.0 = 232.7\ \#$
$H_e = 2.83 \times 470.0 = 1329.4\ \#$
$S = 1329.4 / 4.0 = 332.4\ \#$
$t = (470.0 + 232.7)/4 = 176\ \#$
Total $M_{zz} = (470.0 + 232.7) \times 77.9 + 1329.4 \times 40.0 = 107940\ ''\#$
$t' = 107940 /(9.5 \times 2) = 5681\ \#$
$m = 332 \times 2.5 = 830.9\ ''\#$

CASE II (FIXTURE AT LOW POSITION)

$d = 2.5\ ''$
$D = 9.5\ ''$
$V_d = 470.0\ \#$
$Y = [(120.0 - 34.6) \times 135.0 +(120.0 - 34.6) \times 135.0 +(40.0 + 35.3) \times 100.0 +(40.0 + 35.3) \times 100.0]/ 470.0 = 81.1\ ''$
$X = [(50.6 + 39.5 \times \cos(60)) \times 135.0 +(43.0 + 39.5 \times \cos(60)) \times 135.0 + 35.3 \times 100.0 + 27.5 \times 100.0]/ 470.0 = 51.6\ ''$
$V_e = 0.50 \times 470.0 = 232.7\ \#$
$H_e = 2.83 \times 470.0 = 1329.4\ \#$
$S = 1329.4 / 4.0 = 332.4\ \#$
$t = (470.0 + 232.7)/ 4 = 176\ \#$
Total $M_{zz} = (470.0 + 232.7) \times 51.6 + 1329.4 \times 81.1 = 144071\ ''\#$
$t' = 144071 /(9.5 \times 2) = 7583\ \#$
$m = 332 \times 2.5 = 831\ ''\#$

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CASE III (Same As CASE I, Lateral Forces Applied Diagonaly To Mounting Plate)

$d = 2.5$ "
$D = 13.4$ "
$Vd = 470.0$ #
$Y = 40.0$ "
$X = 77.9$ "
$Ve = 0.50 \times 470.0 = 232.7$ #
$He = 2.83 \times 470.0 = 1329.4$ #
$S = 1329.4 / 4.0 = 332.4$ #
$t = (470.0 + 232.7)/ 4 = 176$ #
Total Mzz = $(470.0 + 232.7)\times 77.9 + 1329.4 \times 40.0 = 107940$ "#
$t' = 107940 /(13.4 \times 1) = 8034$ #
$m = 332 \times 2.5 = 831$ "#

CASES I & II
D= 9.5"

C.G.

CASES III & IV
$R = 9.5(2)^{0.5} = 13.4$"
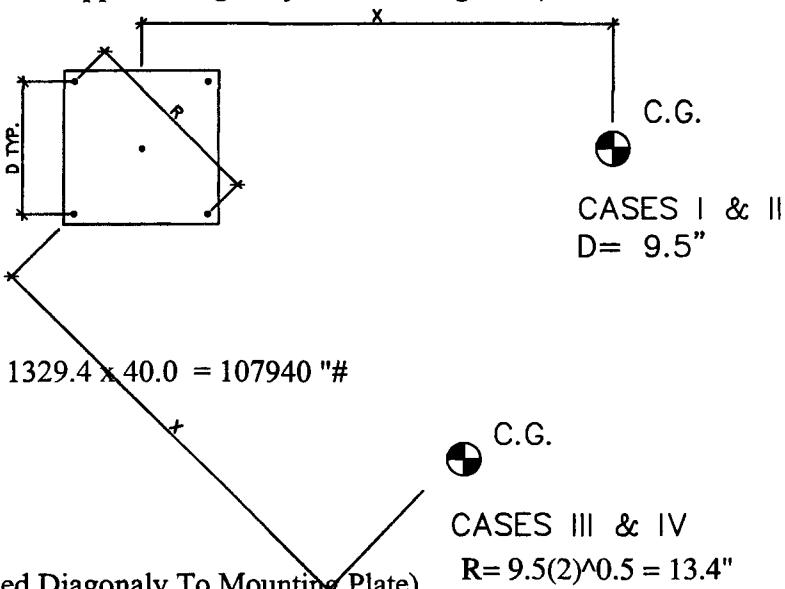
CASE IV
(Same As CASE II, Lateral Forces Applied Diagonaly To Mounting Plate)
$d = 2.5$ "
$D = 13.4$ "
$Vd = 470.0$ #
$Y = 81.1$ "
$X = 51.6$ "
$Ve = 0.50 \times 470.0 = 232.7$ #
$He = 2.83 \times 470.0 = 1329.4$ #
$S = 1329.4 / 4.0 = 332.4$ #
$t = (470.0 + 232.7)/ 4 = 176$ #
Total Mzz = $(470.0 + 232.7)\times 51.6 + 1329.4 \times 81.1 = 144071$ "#
$t' = 144071 /(13.4 \times 1) = 10724$ # GOVERNS
$m = 332 \times 2.5 = 831$ "#

CHECK 7/8" DIA. A490 BOLTS:

ALLOWABLE TENSION: 32500 #
ALLOWABLE SHEAR: 12600 #

$S = 3.14*d^3/32 = 3.14 \times(0.88)^3/ 32.0 = 0.07$ "3
$fb = 830.9 / 0.07 = 12640$ PSI
$Fb = 0.75 \times 36000 = 27000$ PSI

fv/Fv + ft/Ft + fb/Fb = $0.03 + 0.33 + 0.47 = 0.82 <1.0$ OK

USE 7/8" DIA. A490 BOLTS